CLAIMS

What is claimed is:

1. An optical pickup comprising:

a light source to generate a laser beam of 500 nm or less;

an objective lens to focus the laser beam onto a medium;

a photodetector to convert the laser beam reflected from the medium into an electrical signal; and

a collimating lens arranged between said light source and said objective lens, including a diverging lens with diverging power and a focusing lens with focusing power,

wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of said collimating lens, and fn is a focal length of the diverging lens.

2. The optical pickup of claim 1, further comprising a beam splitter between said objective lens and said photodetector, to transmit the laser beam from said light source toward the medium through said objective lens, and to reflect the laser beam reflected from the medium toward said photodetector.

3. The optical pickup of claim 1, further comprising a condensing lens between said photodetector and said beam splitter, to condense the laser beam reflected from the medium onto said photodetector.

4. The optical pickup of claim 2, wherein said collimating lens is arranged between said beam splitter and said light source.

5. The optical pickup of claim 3, wherein said collimating lens is arranged between said beam splitter and said light source.

6. The optical pickup of claim 2, wherein said collimating lens is arranged between said objective lens and said beam splitter.

7. The optical pickup of claim 3, wherein said collimating lens is arranged between said objective lens and said beam splitter.

8. The optical pickup of claim 1, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1\cdot v1)+1/(f2\cdot v2)+\ldots+1/(fn\cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

9. An optical pickup comprising:

first and second light sources, which correspond to first and second media, respectively, to generate laser beams of different wavelengths;

an objective lens to focus the laser beams from said first and second light sources onto the first and second media, respectively;

first and second photodetectors to receive the laser beams emitted from said first and second light sources and reflected from the first and second media, respectively; and

a collimating lens arranged on the optical path of one of the laser beams having a relatively short wavelength, said collimating lens including a diverging lens with diverging power and a focusing lens with focusing power,

wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of said collimating lens, and fn is a focal length of the diverging lens.

10. The optical pickup of claim 9, further comprising a wavelength selecting filter on the optical axis near said objective lens.

11. The optical pickup of claim 9, wherein said first light source emits a laser beam having a wavelength of about 400 nm, and said second light source emits a laser beam having a wavelength of about 650 nm.

12. The optical pickup of claim 10, wherein said first light source emits a laser beam having a wavelength of about 400 nm, and said second light source emits a laser beam having a wavelength of about 650 nm.

13. The optical pickup of claim 9, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

14. The optical pickup of claim 12, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

15. An optical pickup comprising:

an objective lens selectively arranged opposite first and second media;

a first light source arranged on the optical path of said objective lens;

a beam splitter arranged between said objective lens and said first light source;

a second light source arranged on the optical path of the light reflected from said beam splitter;

a first photodetector to receive light emitted from said first light source and reflected from the first medium;

a second photodetector to receive light emitted from said second light source and reflected from the second medium; and

a collimating lens arranged between said objective lens and said beam splitter, said collimating lens including a diverging lens with diverging power and a focusing lens with focusing power,

wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of said collimating lens, and fn is a focal length of the diverging lens.

16. The optical pickup of claim 15, further comprising a wavelength selecting filter between said objective lens and said collimating lens, to control the numerical aperture (NA) of said objective lens.

17. The optical pickup of claim 9, wherein said first light source emits a laser beam having a wavelength of about 400 nm, and said second light source emits a laser beam having a wavelength of about 650 nm.

18. The optical pickup of claim 15, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

$v1, v2, \ldots,$ and vn, are Abbe's numbers of optical materials of the respective lenses.

19. The optical pickup of claim 9, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+\ldots+1/(fn \cdot vn) < 0.0005$, where

$f1, f2, \ldots,$ and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

$v1, v2, \ldots,$ and vn, are Abbe's numbers of optical materials of the respective lenses.

20. An optical pickup comprising:

an objective lens selectively arranged opposite first and second media;

a first light source arranged on the optical path of said objective lens, to emit a laser beam toward the first medium;

first, second and third beam splitters arranged on the optical path at predetermined positions from said first light source toward said objective lens;

a second light source arranged on the optical path of the light reflected by the first beam splitter, to emit a laser beam through the first beam splitter toward the second medium;

a first photodetector arranged on the optical path of the light reflected by the third beam splitter, to receive the laser beam emitted from said first light source and reflected from the first medium;

a second photodetector arranged on the optical path of the light reflected by the second beam splitter, to receive the laser beam emitted from said second light source and reflected from the second medium; and

a collimating lens arranged between the second and third beam splitters, said collimating lens including a diverging lens with diverging power and a focusing lens with focusing power,

wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of said collimating lens, and fn is a focal length of the diverging lens.

21. The optical pickup of claim 20, further comprising a wavelength selecting filter between said objective lens and said collimating lens, to control the numerical aperture (NA) of said objective lens.

22. The optical pickup of claim 20, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

23. The optical pickup of claim 20, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

24. The optical pickup of claim 22, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

25. An optical pickup comprising:

an objective lens selectively arranged opposite first and second media;

a first light source arranged on the optical path of said objective lens, to emit a laser beam toward the first optical disk;

first, second and third beam splitters arranged on the optical path at predetermined positions from said first light source toward said objective lens;

a second light source arranged on the optical path of the light reflected by the first beam splitter, to emit a laser beam through the first beam splitter toward the second medium;

a first photodetector arranged on the optical path of the light reflected by the third beam splitter, to receive the laser beam emitted from said first light source and reflected from the first medium;

a second photodetector arranged on the optical path of the light reflected by the second beam splitter, to receive the laser beam emitted from said second light source and reflected from the second medium; and

a collimating lens arranged between said objective lens and the third beam splitter, said collimating lens including a diverging lens with diverging power and a focusing lens with focusing power,

wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of said collimating lens, and fn is a focal length of the diverging lens.

26. The optical pickup of claim 25, further comprising a wavelength selecting filter between said objective lens and said collimating lens, to control the numerical aperture (NA) of said objective lens.

27. The optical pickup of claim 25, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

28. The optical pickup of claim 25, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

29. The optical pickup of claim 27, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

30. The optical pickup of claim 2, further comprising a condensing lens between said photodetector and said beam splitter, to condense the laser beam reflected from the medium onto said photodetector.

31. The optical pickup of claim 30, wherein said collimating lens is arranged between said beam splitter and said light source.

32. The optical pickup of claim 30, wherein said collimating lens is arranged between said objective lens and said beam splitter.

33. The optical pickup of claim 31, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

$f_1, f_2, \ldots,$ and f_n are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

$v_1, v_2, \ldots,$ and v_n, are Abbe's numbers of optical materials of the respective lenses.

34. The optical pickup of claim 32, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f_1 \cdot v_1) + 1/(f_2 \cdot v_2) + \ldots + 1/(f_n \cdot v_n) < 0.0005$, where

$f_1, f_2, \ldots,$ and f_n are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

$v_1, v_2, \ldots,$ and v_n, are Abbe's numbers of optical materials of the respective lenses.

35. The optical pickup of claim 2, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f_1 \cdot v_1) + 1/(f_2 \cdot v_2) + \ldots + 1/(f_n \cdot v_n) < 0.0005$, where

$f_1, f_2, \ldots,$ and f_n are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

$v_1, v_2, \ldots,$ and v_n, are Abbe's numbers of optical materials of the respective lenses.

36. The optical pickup of claim 5, the optical pickup satisfies the relationship $-0.005 < 1/(f_1 \cdot v_1) + 1/(f_2 \cdot v_2) + \ldots + 1/(f_n \cdot v_n) < 0.0005$, where

$f_1, f_2, \ldots,$ and f_n are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

$v_1, v_2, \ldots,$ and v_n, are Abbe's numbers of optical materials of the respective lenses.

37. The optical pickup of claim 6, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+ \ldots +1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

38. The optical pickup of claim 7, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+ \ldots +1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

39. The optical pickup of claim 11, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

40. The optical pickup of claim 10, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+ \ldots +1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

41. The optical pickup of claim 11, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+ \ldots +1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

42. The optical pickup of claim 10, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

43. The optical pickup of claim 16, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

44. The optical pickup of claim 21, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

45. The optical pickup of claim 44, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

46. The optical pickup of claim 26, wherein said first light source emits the laser beam having a wavelength of about 400 nm, and said second light source emits the laser beam having a wavelength of about 650 nm.

47. The optical pickup of claim 26, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+\ldots+1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

48. The optical pickup of claim 46, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+\ldots+1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the first or second media, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

49. An optical pickup comprising:

a light source to generate a light beam with wavelengths between roughly 400 nm and 650 nm;

an optical element to focus the light beam onto a medium;

a detector to detect the light beam reflected from the medium; and

a collimating lens arranged in an optical path between said light source and said optical element,

wherein the optical pickup focus the light beam onto the medium with negligible aberration.

50. The optical pickup of claim 49, wherein said collimating lens comprises a surface with a diverging power, and satisfies the relationship $-1.5 > f/fn$, where

f is a total focal length of said collimating lens, and

fn is a focal length of the surface with diverging power.

51. The optical pickup of claim 50, further comprising a $\lambda/4$ plate disposed in an optical path between said collimating lens and said optical element.

52. The optical pickup of claim 51, further comprising a beam splitter disposed between said collimating lens and said $\lambda/4$ plate, wherein said beam splitter

transmits the light beam from said collimating lens to said $\lambda/4$ plate, and

reflects the light beam from the medium to said detector.

53. The optical pickup of claim 50, further comprising a $\lambda/4$ plate disposed in an optical path between said collimating lens and said light source.

54. The optical pickup of claim 53, further comprising a beam splitter disposed between said light source and said $\lambda/4$ plate, wherein said beam splitter

transmits the light beam from said light source to said $\lambda/4$ plate, and

reflects the light beam from the medium to said detector.

55. The optical pickup of claim 50, wherein said collimating lens further comprises a focusing lens with focusing power disposed between the surface having the diverging power and the medium.

56. The optical pickup of claim 55, wherein the surface having the diverging power comprises a diverging lens.

57. The optical pickup of claim 56, wherein said optical element comprises an objective lens.

58. The optical pickup of claim 57, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1) + 1/(f2 \cdot v2) + \ldots + 1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

59. The optical detector of claim 58, wherein said light source and said detector comprise a light emitter/detector device that generates the light beam and detects the light beam.

60. An optical pickup comprising:

light sources to emit respective light beams of different wavelengths of less than roughly 500 nm;

an optical element to focus the light beams onto respective media;

detectors to detect respective light beam reflected from the media; and

a collimating lens arranged between said light sources and said optical element, wherein said collimating lens comprises a surface with a diverging power,

wherein the optical pickup focuses light beams onto respective media with negligible aberration.

61. The optical pickup of claim 60, wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where

f is a total focal length of said collimating lens, and

fn is a focal length of the surface with diverging power.

62 The optical pickup of claim 61, wherein said collimating lens further comprises a focusing lens with focusing power disposed between the surface having the diverging power and the media.

63. The optical pickup of claim 62, wherein the surface having the diverging power comprises a diverging lens.

64. The optical pickup of claim 63, wherein said optical element comprises an objective lens.

65. The optical pickup of claim 64, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+\ldots+1/(fn \cdot vn) < 0.0005$, where

f1, f2, ..., and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

v1, v2, ..., and vn, are Abbe's numbers of optical materials of the respective lenses.

66. The optical detector of claim 65, wherein at least one of said light sources and one of said detectors comprise a light emitter/detector device that emits and detects a respective light beam.

67. The optical detector of claim 65, further comprising a wavelength selecting filter, wherein said wavelength selecting filter controls the numerical aperture of said objective lens based upon the wavelength of respective light beams.

68. The optical detector of claim 67, further comprising beams splitters disposed between respective light sources and said collimating lens, wherein said beam splitters reflect respective light beams, and transmit other incident light beams.

69. The optical detector of claim 68, wherein at least one of the light beams has a wavelength of about 400 nm, and another of the light beams has a wavelength of about 650 nm.

70. The optical detector of claim 68, where at least one of said beam splitters is disposed between said wavelength selecting filter and said collimating lens and reflects at least one of the light beams from a respective media onto a respective detector.

71. A collimating lens comprising:

a diverging lens with diverging power,

wherein the collimating lens satisfies the relationship $-1.5 > f/fn$, where f is a total focal length of the collimating lens, and fn is a focal length of said diverging lens.

72. The collimating lens of claim 71, further comprising:

a focusing lens with focusing power disposed between a light source and said diverging lens.

73. The collimating lens of claim 71, further comprising:

a focusing lens with focusing power, wherein said diverging lens is disposed between a light source and said focusing lens.

74. An optical system comprising:

a light sources to emit a light beam of less than roughly 500 nm;

an optical element to focus the light beam onto respective media;

detectors to detect respective light beam reflected from the media; and

a collimating lens arranged between said light source and said optical element, wherein said collimating lens comprises a surface with a diverging power,

wherein the optical system focuses the light beam onto respective media with negligible aberration.

75. The optical system of claim 74, wherein said collimating lens satisfies the relationship $-1.5 > f/fn$, where

f is a total focal length of said collimating lens, and

fn is a focal length of the surface with diverging power.

76 The optical system of claim 75, wherein said collimating lens further comprises a focusing lens with focusing power disposed between the surface having the diverging power and the media.

77. The optical system of claim76, wherein the surface having the diverging power comprises a diverging lens.

78. The optical system of claim 77, wherein said optical element comprises an objective lens.

79. The optical system of claim 78, wherein the optical pickup satisfies the relationship $-0.005 < 1/(f1 \cdot v1)+1/(f2 \cdot v2)+\ldots+1/(fn \cdot vn) < 0.0005$, where

$f1, f2, \ldots,$ and fn are focal lengths of respective lenses, including said objective and collimating lenses, from said light source toward the medium, and

$v1, v2, \ldots,$ and vn, are Abbe's numbers of optical materials of the respective lenses.

80. The optical system of claim 79, said light source and said detector comprise a light emitter/detector device that emits and detects the light beam.

81. The optical system of claim 79, further comprising beams splitters disposed between said light source and said collimating lens, wherein said beam splitters reflect and transmit other the light beam.

82. The optical system of claim 81, where at least one of said beam splitters reflects the light beam from respective media onto said detector.